SEQUENCE LISTING

<110> WACHI, Masaaki
NAGAI, Kazuo

<120> A Gene Coding for Penicillin Binding Protein
and a Method for Producing L-Glutamic Acid

<130> OP843-PCT

<141> 1999-03-05

<150> JP 10-55608
<151> 1998-03-06

<160> 6

<170> PatentIn Ver. 2.0

<210> 1
<211> 5347
<212> DNA
<213> Brevibacterium lactofermentum

<220>
<221> CDS
<222> (881)..(2623)

<220>
<221> CDS
<222> (2790)..(4454)

<220>
<221> CDS
<222> (4467)..(5345)

<400> 1
aagcttcggg gaggggcgcg tcgataagca cgcaacctcg tcgtgacatg gcgccggaaa 60

ggaaacaacc cgggccctgg tgaaccctgg cgtgcagcaa cgcgtaattg atgcagcaca 120

agctgggctc tcagcaggtt atgtcggtgc gtggtcgccg cgttgaggca aaacgtgctg 180

atcctaaggt gatccagctg tctgtgctgg tggttatcct gctgtgcgtt ggtgttggcg 240

cgaccatggg tctgtccgga acgtctacac agcagacttt ccagttgcag gaacttcagg 300

caactgaaac ggatttgagc aatcgcattg agtctctcaa ccgagatgtg gaagatgctc 360

gctcagcagc aaccttggca gcgaatgcta cggagatggg cttggtatcc ccagtggaac 420

ctggcgtgct cgcagtgcag gaaaacggtg atgttgtgga ggagcgcgaa caaatccaga 480

gacacgccct atagttgaca tcaatggaca acagacccga ccaaatcggg catcaagcaa 540

ccctgacgag actaacgcat actgaaaacc tccaggcgat tccacaagaa gcagcagctc 600

cgccgtatca gaccaacact gttccttatg ctgcaaccac cggacaagca ggtggcgcag 660

```
ggcagtgact ttccccagca atggcagaag tcggggcgag cgtgcgggac gtgaagatac 720

gtcccgccgt tcggcgtatc aggacgaaag cagaagagcc gctagagagc gcgaacttac 780

gcgacgcagc ggtaaagcta aaggcgtaaa ccaagaagaa ggagtgacct accggcctaa 840

atcttcaacc cagggcggcg cacgcaagcg acgtgtgaac atg gtt acc cgt atc   895
                                            Met Val Thr Arg Ile
                                              1               5

gca ttg gtc atc gct ggc gta ctg atc att cgc ctc ggc tgg gtc caa   943
Ala Leu Val Ile Ala Gly Val Leu Ile Ile Arg Leu Gly Trp Val Gln
                   10                  15                  20

gtt gtc tgg gga cca gaa ctg tcc ctc aat gct tcg gaa cag cgc acc   991
Val Val Trp Gly Pro Glu Leu Ser Leu Asn Ala Ser Glu Gln Arg Thr
               25                  30                  35

cgc gtg tac gta gat cct gca cgc cgt gga acc atc gtg gac cgc gaa  1039
Arg Val Tyr Val Asp Pro Ala Arg Arg Gly Thr Ile Val Asp Arg Glu
           40                  45                  50

gga aac cag atg gcg tac acg atg cag gca cgt tcg ctg acg gtt tct  1087
Gly Asn Gln Met Ala Tyr Thr Met Gln Ala Arg Ser Leu Thr Val Ser
     55                  60                  65

ccg aac atc atg cgt gag gaa tta aag acc gga act gat ctg gcc ttg  1135
Pro Asn Ile Met Arg Glu Glu Leu Lys Thr Gly Thr Asp Leu Ala Leu
 70                  75                  80                  85

cgt ttg gcg gct gaa gaa acc gat ccg gaa aac gtg gcc agc tat gtg  1183
Arg Leu Ala Ala Glu Glu Thr Asp Pro Glu Asn Val Ala Ser Tyr Val
                   90                  95                 100

acc atc gaa gaa ggc aac gcg tat gtt ttt gcg tct gaa gaa cag cgc  1231
Thr Ile Glu Glu Gly Asn Ala Tyr Val Phe Ala Ser Glu Glu Gln Arg
              105                 110                 115

gaa acc att ctg tcc gac aag gta gaa gag cgt att caa agc att gcg  1279
Glu Thr Ile Leu Ser Asp Lys Val Glu Glu Arg Ile Gln Ser Ile Ala
          120                 125                 130

gat cgg atc cct gag atc atc aaa tcc cat gac caa gat gtc act gga  1327
Asp Arg Ile Pro Glu Ile Ile Lys Ser His Asp Gln Asp Val Thr Gly
     135                 140                 145

att tcc tct gag gag atc ctg gac aag ctc aat gca gat agc cag tat  1375
Ile Ser Ser Glu Glu Ile Leu Asp Lys Leu Asn Ala Asp Ser Gln Tyr
150                 155                 160                 165

gag gtg ctc gtc cgc aat gtt gat ccc gat gta gcg tca gaa atc acc  1423
Glu Val Leu Val Arg Asn Val Asp Pro Asp Val Ala Ser Glu Ile Thr
                   170                 175                 180

gat gag atg ccc agc gtc gca gct gat cat caa gac atc cgc caa tac  1471
Asp Glu Met Pro Ser Val Ala Ala Asp His Gln Asp Ile Arg Gln Tyr
              185                 190                 195
```

```
cca aac ggc gcg att ggt gaa aac atc atc ggt cga atc agc atg gac    1519
Pro Asn Gly Ala Ile Gly Glu Asn Ile Ile Gly Arg Ile Ser Met Asp
        200                 205                 210

ggc gaa ggc cag ttc ggc ttt gag gct tcc aac gat tcc ctg ttg gca    1567
Gly Glu Gly Gln Phe Gly Phe Glu Ala Ser Asn Asp Ser Leu Leu Ala
    215                 220                 225

gga aac aac ggt cgc tca acc cag gac atg tcc att ttg gga caa gca    1615
Gly Asn Asn Gly Arg Ser Thr Gln Asp Met Ser Ile Leu Gly Gln Ala
230                 235                 240                 245

atc ccg ggc acg ttg agg gat caa att cca gcc att gat ggt gcc agc    1663
Ile Pro Gly Thr Leu Arg Asp Gln Ile Pro Ala Ile Asp Gly Ala Ser
                250                 255                 260

gtt gaa ctc acc gtt gat ctg gat ctg caa acc tat gtg cag cag gca    1711
Val Glu Leu Thr Val Asp Leu Asp Leu Gln Thr Tyr Val Gln Gln Ala
            265                 270                 275

ttg gag cag gcg aaa gct aac tcc ggt gca gaa aac gcc tcc gct gtg    1759
Leu Glu Gln Ala Lys Ala Asn Ser Gly Ala Glu Asn Ala Ser Ala Val
    280                     285                 290

gtt ctt gat gcc gag acc gct gag gtt ttg gcg atg gca aac acc gat    1807
Val Leu Asp Ala Glu Thr Ala Glu Val Leu Ala Met Ala Asn Thr Asp
    295                 300                 305

acc atc aac ccc aac gaa gac acg gga aag cag att gag cag ggc aag    1855
Thr Ile Asn Pro Asn Glu Asp Thr Gly Lys Gln Ile Glu Gln Gly Lys
310                 315                 320                 325

agc ttt gac aat cct tct gtc acc cac ccc ttc gag cct ggt tct gta    1903
Ser Phe Asp Asn Pro Ser Val Thr His Pro Phe Glu Pro Gly Ser Val
                330                 335                 340

gcc aag gtg att act gca gca ggc gta att caa gac ggc ttg act act    1951
Ala Lys Val Ile Thr Ala Ala Gly Val Ile Gln Asp Gly Leu Thr Thr
            345                 350                 355

cca gat gaa gtg ttg cag gta ccg ggc agt att gaa atg gcc ggt gtt    1999
Pro Asp Glu Val Leu Gln Val Pro Gly Ser Ile Glu Met Ala Gly Val
        360                 365                 370

tct gtc ggt gat gcg tgg gac cac ggt gtc gtt ccc tat acc act gca    2047
Ser Val Gly Asp Ala Trp Asp His Gly Val Val Pro Tyr Thr Thr Ala
    375                 380                 385

gga att ttt ggt aag tcc tcg aat gta ggc act ctg atg ctt gcg cac    2095
Gly Ile Phe Gly Lys Ser Ser Asn Val Gly Thr Leu Met Leu Ala His
390                 395                 400                 405

ggt ctt ggt gaa gat aaa ttt gct gat tac ctg gaa cga ttc ggt gtg    2143
Gly Leu Gly Glu Asp Lys Phe Ala Asp Tyr Leu Glu Arg Phe Gly Val
                410                 415                 420

gga cag tca acg ggt att gag ctt ccg agc gaa tcc caa ggc ctg ctg    2191
```

```
Gly Gln Ser Thr Gly Ile Glu Leu Pro Ser Glu Ser Gln Gly Leu Leu
            425                 430                 435

ccc gca cgt gag cag tgg tct ggc ggt act ttt gct aac ctg ccc atc    2239
Pro Ala Arg Glu Gln Trp Ser Gly Gly Thr Phe Ala Asn Leu Pro Ile
        440                 445                 450

ggt cag ggt atg tcg atc acc acg ttg caa atg gct gga atc tac caa    2287
Gly Gln Gly Met Ser Ile Thr Thr Leu Gln Met Ala Gly Ile Tyr Gln
    455                 460                 465

gcc ttg gcc aac gat ggt gaa cgc att gaa ccg cgg atc atc aag agc    2335
Ala Leu Ala Asn Asp Gly Glu Arg Ile Glu Pro Arg Ile Ile Lys Ser
470                 475                 480                 485

gtg act gat tct gac gga aca gtc cta gag cag ccg gaa ccc gat aaa    2383
Val Thr Asp Ser Asp Gly Thr Val Leu Glu Gln Pro Glu Pro Asp Lys
                490                 495                 500

atc cag gtt gtc agc gct gaa gct gcc cgc acc acg gtg gat atg ttt    2431
Ile Gln Val Val Ser Ala Glu Ala Ala Arg Thr Thr Val Asp Met Phe
            505                 510                 515

agg tct gtc acc cag gtt gat cca ctt gga gtg cac aag gta ccg ctc    2479
Arg Ser Val Thr Gln Val Asp Pro Leu Gly Val His Lys Val Pro Leu
        520                 525                 530

cag acg cct cca ttg agg gtt atc aaa tct cag gta aga cag gta cgg    2527
Gln Thr Pro Pro Leu Arg Val Ile Lys Ser Gln Val Arg Gln Val Arg
    535                 540                 545

cgc aaa aag ttg acc cca aca cgg gcg cgt act cta act cgc aat act    2575
Arg Lys Lys Leu Thr Pro Thr Arg Ala Arg Thr Leu Thr Arg Asn Thr
550                 555                 560                 565

gga tta cct tct cgg gta ttg cac ccg ctg atg atc ctc gat ttg ttg    2623
Gly Leu Pro Ser Arg Val Leu His Pro Leu Met Ile Leu Asp Leu Leu
                570                 575                 580

tagccatcat gcttgatgag ccagaacgcg gagtccacgg tggtggcggc caaaccgcag 2683

cacctttgtt caaagacatc gccacctggt tgctcaaccg cgacaacatc ccactgtctg 2743

cagccaccga accgatcatc cttcaagctc aataactcaa acagaa gtg tct ttt    2798
                                                   Val Ser Phe
                                                     1

gta gaa ttt cat aat ctg aac ttt tgt ttg aac tct ttt cgg cat cac    2846
Val Glu Phe His Asn Leu Asn Phe Cys Leu Asn Ser Phe Arg His His

cca cgt gcc gcg tcc gaa tta tta aca cct aga aac ctg tgg agg aga    2894
Pro Arg Ala Ala Ser Glu Leu Leu Thr Pro Arg Asn Leu Trp Arg Arg
 20                 25                  30                  35

gaa aac cat ggc aac cac gtt gct gga cct cac caa act tat cga tgg    2942
Glu Asn His Gly Asn His Val Ala Gly Pro His Gln Thr Tyr Arg Trp
                40                  45                  50
```

cat cct caa ggg ctc tgc cag ggc gtt ccc gct cac gca gta ggg gaa 2990
His Pro Gln Gly Leu Cys Gln Gly Val Pro Ala His Ala Val Gly Glu
55 60 65

caa gca atc gcg gct att ggt ctt gac tcc tcc agc ttg cct acc tcg 3038
Gln Ala Ile Ala Ala Ile Gly Leu Asp Ser Ser Ser Leu Pro Thr Ser
70 75 80

gac gct att ttt gct gca gtt cca gga acc cgc act cac ggc gca cag 3086
Asp Ala Ile Phe Ala Ala Val Pro Gly Thr Arg Thr His Gly Ala Gln
85 90 95

ttt gca ggt acg gat aac gct gcg aaa gct gtg gcc att ttg act gac 3134
Phe Ala Gly Thr Asp Asn Ala Ala Lys Ala Val Ala Ile Leu Thr Asp
100 105 110 115

gca gct gga ctt gag gtg ctc aac gaa gca gga gag acc cgc cca atc 3182
Ala Ala Gly Leu Glu Val Leu Asn Glu Ala Gly Glu Thr Arg Pro Ile
120 125 130

atc gtt gtt gat gat gtc cgc gca gta ctt ggc gca gca tca tca agc 3230
Ile Val Val Asp Asp Val Arg Ala Val Leu Gly Ala Ala Ser Ser Ser
135 140 145

att tat ggc gat cct tca aaa gat ttc acg ctc att gga gtc act gga 3278
Ile Tyr Gly Asp Pro Ser Lys Asp Phe Thr Leu Ile Gly Val Thr Gly
150 155 160

acc tca ggt aaa acc acc acc agc tac ctc ttg gaa aaa gga ctc atg 3326
Thr Ser Gly Lys Thr Thr Thr Ser Tyr Leu Leu Glu Lys Gly Leu Met
165 170 175

gag gca ggc cac aaa gtt ggt ttg atc ggc acc aca ggt aca cgt ata 3374
Glu Ala Gly His Lys Val Gly Leu Ile Gly Thr Thr Gly Thr Arg Ile
180 185 190 195

gat ggg gaa gaa gta ccc acg aag ctc acc act cca gaa gcg ccg act 3422
Asp Gly Glu Glu Val Pro Thr Lys Leu Thr Thr Pro Glu Ala Pro Thr
200 205 210

ctg cag gca ttg ttt gct cga atg cgc gat cac ggt gtc acc cac gtg 3470
Leu Gln Ala Leu Phe Ala Arg Met Arg Asp His Gly Val Thr His Val
215 220 225

gtg atg gaa gta tcc agc cat gca ttg tca ttg ggc agg gtt gcg ggt 3518
Val Met Glu Val Ser Ser His Ala Leu Ser Leu Gly Arg Val Ala Gly
230 235 240

tcc cac ttt gat gta gct gcg ttt acc aac ctg tcg cag gat cac ctt 3566
Ser His Phe Asp Val Ala Ala Phe Thr Asn Leu Ser Gln Asp His Leu
245 250 255

gat ttc cac ccc acc atg gat gat tac ttt gac gcg aag gca ttg ttc 3614
Asp Phe His Pro Thr Met Asp Asp Tyr Phe Asp Ala Lys Ala Leu Phe
260 265 270 275

ttc cgc gca gat tct cca ctt gtg gct gac aaa cag gtc gtg tgc gtg 3662
Phe Arg Ala Asp Ser Pro Leu Val Ala Asp Lys Gln Val Val Cys Val

```
                    280                 285                 290

gat gat tct tgg ggt cag cgc atg gcc agc gtg gca gcg gat gtg caa   3710
Asp Asp Ser Trp Gly Gln Arg Met Ala Ser Val Ala Ala Asp Val Gln
            295                 300                 305

aca gta tcc acc ctt ggg caa gaa gca gac ttc agc gct aca gat atc   3758
Thr Val Ser Thr Leu Gly Gln Glu Ala Asp Phe Ser Ala Thr Asp Ile
        310                 315                 320

aat gtc agc gac tct ggc gcc cag agt ttt aag atc aac gcc ccc tca   3806
Asn Val Ser Asp Ser Gly Ala Gln Ser Phe Lys Ile Asn Ala Pro Ser
    325                 330                 335

aac cag tcc tac cag gtc gag cta gcc ctt cca ggt gcg ttc aac gtt   3854
Asn Gln Ser Tyr Gln Val Glu Leu Ala Leu Pro Gly Ala Phe Asn Val
340                 345                 350                 355

gct aac gcc acg ttg gca ttt gcc gct gcg gca ccg tgg gtg ttg atg   3902
Ala Asn Ala Thr Leu Ala Phe Ala Ala Ala Ala Pro Trp Val Leu Met
                360                 365                 370

gcg acg ttt gct cga ggc atg tcc aag gtc gcg gtt cca ggc cgt atg   3950
Ala Thr Phe Ala Arg Gly Met Ser Lys Val Ala Val Pro Gly Arg Met
            375                 380                 385

gaa cgc att gat gag gga caa gac ttc ctt gca gtg gtg gat tat gcc   3998
Glu Arg Ile Asp Glu Gly Gln Asp Phe Leu Ala Val Val Asp Tyr Ala
        390                 395                 400

cac aag cct gct gca gtg gct gct gtg ttg gat acg ttg agg acc cag   4046
His Lys Pro Ala Ala Val Ala Ala Val Leu Asp Thr Leu Arg Thr Gln
    405                 410                 415

att gac ggg cgc ctc gga agt ggt tat cgg tgc tgg tgg aga cgc gat   4094
Ile Asp Gly Arg Leu Gly Ser Gly Tyr Arg Cys Trp Trp Arg Arg Asp
420                 425                 430                 435

tcc acc aag cgt ggc ccc atg ggc agt tgt ccg cac agg tct gga tct   4142
Ser Thr Lys Arg Gly Pro Met Gly Ser Cys Pro His Arg Ser Gly Ser
                440                 445                 450

agt tat tgt act gat gca aac ctc gtc aga gtg gct ggc acg att cgc   4190
Ser Tyr Cys Thr Asp Ala Asn Leu Val Arg Val Ala Gly Thr Ile Arg
            455                 460                 465

gca gca gtc act gca gga gca cag cag ggt gct tca gag tcc gaa cga   4238
Ala Ala Val Thr Ala Gly Ala Gln Gln Gly Ala Ser Glu Ser Glu Arg
        470                 475                 480

ccg gtg gaa gtc cta gaa att ggt gac cgt gca gaa gca att cgc gtt   4286
Pro Val Glu Val Leu Glu Ile Gly Asp Arg Ala Glu Ala Ile Arg Val
    485                 490                 495

ttg gtc gag tgg gca cag cct gga gat ggc att gta gta gct gga aaa   4334
Leu Val Glu Trp Ala Gln Pro Gly Asp Gly Ile Val Val Ala Gly Lys
500                 505                 510                 515
```

```
ggc cat gaa gtt gga caa cta gtt gct ggt gtc acc cac cat ttt gat    4382
Gly His Glu Val Gly Gln Leu Val Ala Gly Val Thr His His Phe Asp
                520                 525                 530

gac cgc gaa gaa ggt cgc gct gct ttg aca gaa aag ctc aac aat aaa    4430
Asp Arg Glu Glu Gly Arg Ala Ala Leu Thr Glu Lys Leu Asn Asn Lys
            535                 540                 545

ctt ccc ctt act acg gaa gaa gga taggccacag tc atg atc aca atg acc 4481
Leu Pro Leu Thr Thr Glu Glu Gly                Met Ile Thr Met Thr
        550                 555                  1

ctt ggg gaa atc gct gac atc gtt gga ggc agg cta act ggc ggt gct    4529
Leu Gly Glu Ile Ala Asp Ile Val Gly Gly Arg Leu Thr Gly Gly Ala
  5                 10                  15                  20

caa gaa gat acg ctt gtg agc tcc agc gtg gaa ttt gat tct cga tcc    4577
Gln Glu Asp Thr Leu Val Ser Ser Ser Val Glu Phe Asp Ser Arg Ser
                25                  30                  35

ctc aca ccg ggt ggc ttg ttt tta gca ctt ccg ggt gct cgt gta gac    4625
Leu Thr Pro Gly Gly Leu Phe Leu Ala Leu Pro Gly Ala Arg Val Asp
            40                  45                  50

ggc cat gat ttt gct gca act gca att gag aaa ggt gcg gtc gca gta    4673
Gly His Asp Phe Ala Ala Thr Ala Ile Glu Lys Gly Ala Val Ala Val
        55                  60                  65

ttg gca gcc cgt gag gtt gac gta cct gcg atc gtc gtg cct cca gta    4721
Leu Ala Ala Arg Glu Val Asp Val Pro Ala Ile Val Val Pro Pro Val
    70                  75                  80

aaa atc cag gaa tcc aat gct gac att tat gct cat gaa cca gat ggg    4769
Lys Ile Gln Glu Ser Asn Ala Asp Ile Tyr Ala His Glu Pro Asp Gly
 85                 90                  95                  100

cat ggc gcg gcg gta gtg gag gcg ttg tct cgg ttg gct cgc cac gtg    4817
His Gly Ala Ala Val Val Glu Ala Leu Ser Arg Leu Ala Arg His Val
                105                 110                 115

gtg gat atc tgc gtg gct ggc cat caa ttg aac gtt gtg gct att act    4865
Val Asp Ile Cys Val Ala Gly His Gln Leu Asn Val Val Ala Ile Thr
            120                 125                 130

ggt tct gcg gga aag act tct acg aag gat ttc atc gcg acg gtt ctt    4913
Gly Ser Ala Gly Lys Thr Ser Thr Lys Asp Phe Ile Ala Thr Val Leu
        135                 140                 145

ggc caa gat ggg cca act gtg gca cct ccg ggc tcg ttt aac aat gag    4961
Gly Gln Asp Gly Pro Thr Val Ala Pro Pro Gly Ser Phe Asn Asn Glu
    150                 155                 160

ctt ggt ttg cca cac acc gtc cgc tgc aca acc gat act aag tat ttg    5009
Leu Gly Leu Pro His Thr Val Arg Cys Thr Thr Asp Thr Lys Tyr Leu
165                 170                 175                 180

gtg gct gag atg tcc gcg cgt ggc att gga cat att aag cac ctg aca    5057
Val Ala Glu Met Ser Ala Arg Gly Ile Gly His Ile Lys His Leu Thr
```

```
                185                 190                 195

gag att cgt ccg cca cgg att gca gct gtg ctc aac gtc ggc cat gcg   5105
Glu Ile Arg Pro Pro Arg Ile Ala Ala Val Leu Asn Val Gly His Ala
            200                 205                 210

cac ctg ggt gaa ttt gga tcc cgc gag aat atc gcg cag gca aaa ggc   5153
His Leu Gly Glu Phe Gly Ser Arg Glu Asn Ile Ala Gln Ala Lys Gly
        215                 220                 225

gag atc att gaa gcg ctg ccc tcg aag aaa acg ggt ggg gta gca gtc   5201
Glu Ile Ile Glu Ala Leu Pro Ser Lys Lys Thr Gly Gly Val Ala Val
    230                 235                 240

ctt aac gct gac gat cct ttt gtc gcc cgg atg gct cca cgc act aag   5249
Leu Asn Ala Asp Asp Pro Phe Val Ala Arg Met Ala Pro Arg Thr Lys
245                 250                 255                 260

gcg cgc gtg gtg tgg ttt acc acc gat gca ggc caa gca aaa aag tct   5297
Ala Arg Val Val Trp Phe Thr Thr Asp Ala Gly Gln Ala Lys Lys Ser
                265                 270                 275

gat tat tgg gca acg agt att tca ctg gac gct gtt gcg cgg gca agc   5345
Asp Tyr Trp Ala Thr Ser Ile Ser Leu Asp Ala Val Ala Arg Ala Ser
            280                 285                 290

tt                                                               5347
```

<210> 2
<211> 581
<212> PRT
<213> Brevibacterium lactofermentum

<400> 2

```
Met Val Thr Arg Ile Ala Leu Val Ile Ala Gly Val Leu Ile Ile Arg
  1               5                  10                  15

Leu Gly Trp Val Gln Val Val Trp Gly Pro Glu Leu Ser Leu Asn Ala
            20                  25                  30

Ser Glu Gln Arg Thr Arg Val Tyr Val Asp Pro Ala Arg Arg Gly Thr
        35                  40                  45

Ile Val Asp Arg Glu Gly Asn Gln Met Ala Tyr Thr Met Gln Ala Arg
    50                  55                  60

Ser Leu Thr Val Ser Pro Asn Ile Met Arg Glu Glu Leu Lys Thr Gly
65                  70                  75                  80

Thr Asp Leu Ala Leu Arg Leu Ala Ala Glu Glu Thr Asp Pro Glu Asn
                85                  90                  95

Val Ala Ser Tyr Val Thr Ile Glu Glu Gly Asn Ala Tyr Val Phe Ala
            100                 105                 110

Ser Glu Glu Gln Arg Glu Thr Ile Leu Ser Asp Lys Val Glu Glu Arg
        115                 120                 125
```

```
Ile Gln Ser Ile Ala Asp Arg Ile Pro Glu Ile Ile Lys Ser His Asp
    130                 135                 140

Gln Asp Val Thr Gly Ile Ser Ser Glu Glu Ile Leu Asp Lys Leu Asn
145                 150                 155                 160

Ala Asp Ser Gln Tyr Glu Val Leu Val Arg Asn Val Asp Pro Asp Val
                165                 170                 175

Ala Ser Glu Ile Thr Asp Glu Met Pro Ser Val Ala Ala Asp His Gln
            180                 185                 190

Asp Ile Arg Gln Tyr Pro Asn Gly Ala Ile Gly Glu Asn Ile Ile Gly
        195                 200                 205

Arg Ile Ser Met Asp Gly Glu Gly Gln Phe Gly Phe Glu Ala Ser Asn
    210                 215                 220

Asp Ser Leu Leu Ala Gly Asn Asn Gly Arg Ser Thr Gln Asp Met Ser
225                 230                 235                 240

Ile Leu Gly Gln Ala Ile Pro Gly Thr Leu Arg Asp Gln Ile Pro Ala
                245                 250                 255

Ile Asp Gly Ala Ser Val Glu Leu Thr Val Asp Leu Asp Leu Gln Thr
            260                 265                 270

Tyr Val Gln Gln Ala Leu Glu Gln Ala Lys Ala Asn Ser Gly Ala Glu
        275                 280                 285

Asn Ala Ser Ala Val Val Leu Asp Ala Glu Thr Ala Glu Val Leu Ala
    290                 295                 300

Met Ala Asn Thr Asp Thr Ile Asn Pro Asn Glu Asp Thr Gly Lys Gln
305                 310                 315                 320

Ile Glu Gln Gly Lys Ser Phe Asp Asn Pro Ser Val Thr His Pro Phe
                325                 330                 335

Glu Pro Gly Ser Val Ala Lys Val Ile Thr Ala Ala Gly Val Ile Gln
            340                 345                 350

Asp Gly Leu Thr Thr Pro Asp Glu Val Leu Gln Val Pro Gly Ser Ile
        355                 360                 365

Glu Met Ala Gly Val Ser Val Gly Asp Ala Trp Asp His Gly Val Val
    370                 375                 380

Pro Tyr Thr Thr Ala Gly Ile Phe Gly Lys Ser Ser Asn Val Gly Thr
385                 390                 395                 400

Leu Met Leu Ala His Gly Leu Gly Glu Asp Lys Phe Ala Asp Tyr Leu
                405                 410                 415

Glu Arg Phe Gly Val Gly Gln Ser Thr Gly Ile Glu Leu Pro Ser Glu
            420                 425                 430
```

Ser Gln Gly Leu Leu Pro Ala Arg Glu Gln Trp Ser Gly Gly Thr Phe
435 440 445

Ala Asn Leu Pro Ile Gly Gln Gly Met Ser Ile Thr Thr Leu Gln Met
450 455 460

Ala Gly Ile Tyr Gln Ala Leu Ala Asn Asp Gly Glu Arg Ile Glu Pro
465 470 475 480

Arg Ile Ile Lys Ser Val Thr Asp Ser Asp Gly Thr Val Leu Glu Gln
485 490 495

Pro Glu Pro Asp Lys Ile Gln Val Val Ser Ala Glu Ala Ala Arg Thr
500 505 510

Thr Val Asp Met Phe Arg Ser Val Thr Gln Val Asp Pro Leu Gly Val
515 520 525

His Lys Val Pro Leu Gln Thr Pro Pro Leu Arg Val Ile Lys Ser Gln
530 535 540

Val Arg Gln Val Arg Arg Lys Lys Leu Thr Pro Thr Arg Ala Arg Thr
545 550 555 560

Leu Thr Arg Asn Thr Gly Leu Pro Ser Arg Val Leu His Pro Leu Met
565 570 575

Ile Leu Asp Leu Leu
580

<210> 3
<211> 555
<212> PRT
<213> Brevibacterium lactofermentum

<400> 3
Val Ser Phe Val Glu Phe His Asn Leu Asn Phe Cys Leu Asn Ser Phe
1 5 10 15

Arg His His Pro Arg Ala Ala Ser Glu Leu Leu Thr Pro Arg Asn Leu
20 25 30

Trp Arg Arg Glu Asn His Gly Asn His Val Ala Gly Pro His Gln Thr
35 40 45

Tyr Arg Trp His Pro Gln Gly Leu Cys Gln Gly Val Pro Ala His Ala
50 55 60

Val Gly Glu Gln Ala Ile Ala Ala Ile Gly Leu Asp Ser Ser Ser Leu
65 70 75 80

Pro Thr Ser Asp Ala Ile Phe Ala Ala Val Pro Gly Thr Arg Thr His
85 90 95

Gly Ala Gln Phe Ala Gly Thr Asp Asn Ala Ala Lys Ala Val Ala Ile
100 105 110

```
Leu Thr Asp Ala Ala Gly Leu Glu Val Leu Asn Glu Ala Gly Glu Thr
        115                 120                 125

Arg Pro Ile Ile Val Val Asp Asp Val Arg Ala Val Leu Gly Ala Ala
    130                 135                 140

Ser Ser Ser Ile Tyr Gly Asp Pro Ser Lys Asp Phe Thr Leu Ile Gly
145                 150                 155                 160

Val Thr Gly Thr Ser Gly Lys Thr Thr Thr Ser Tyr Leu Leu Glu Lys
                165                 170                 175

Gly Leu Met Glu Ala Gly His Lys Val Gly Leu Ile Gly Thr Thr Gly
            180                 185                 190

Thr Arg Ile Asp Gly Glu Glu Val Pro Thr Lys Leu Thr Thr Pro Glu
        195                 200                 205

Ala Pro Thr Leu Gln Ala Leu Phe Ala Arg Met Arg Asp His Gly Val
    210                 215                 220

Thr His Val Val Met Glu Val Ser Ser His Ala Leu Ser Leu Gly Arg
225                 230                 235                 240

Val Ala Gly Ser His Phe Asp Val Ala Ala Phe Thr Asn Leu Ser Gln
                245                 250                 255

Asp His Leu Asp Phe His Pro Thr Met Asp Asp Tyr Phe Asp Ala Lys
            260                 265                 270

Ala Leu Phe Phe Arg Ala Asp Ser Pro Leu Val Ala Asp Lys Gln Val
        275                 280                 285

Val Cys Val Asp Asp Ser Trp Gly Gln Arg Met Ala Ser Val Ala Ala
    290                 295                 300

Asp Val Gln Thr Val Ser Thr Leu Gly Gln Glu Ala Asp Phe Ser Ala
305                 310                 315                 320

Thr Asp Ile Asn Val Ser Asp Ser Gly Ala Gln Ser Phe Lys Ile Asn
                325                 330                 335

Ala Pro Ser Asn Gln Ser Tyr Gln Val Glu Leu Ala Leu Pro Gly Ala
            340                 345                 350

Phe Asn Val Ala Asn Ala Thr Leu Ala Phe Ala Ala Ala Ala Pro Trp
        355                 360                 365

Val Leu Met Ala Thr Phe Ala Arg Gly Met Ser Lys Val Ala Val Pro
    370                 375                 380

Gly Arg Met Glu Arg Ile Asp Glu Gly Gln Asp Phe Leu Ala Val Val
385                 390                 395                 400

Asp Tyr Ala His Lys Pro Ala Ala Val Ala Ala Val Leu Asp Thr Leu
                405                 410                 415

Arg Thr Gln Ile Asp Gly Arg Leu Gly Ser Gly Tyr Arg Cys Trp Trp
```

420 425 430

Arg Arg Asp Ser Thr Lys Arg Gly Pro Met Gly Ser Cys Pro His Arg
435 440 445

Ser Gly Ser Ser Tyr Cys Thr Asp Ala Asn Leu Val Arg Val Ala Gly
450 455 460

Thr Ile Arg Ala Ala Val Thr Ala Gly Ala Gln Gln Gly Ala Ser Glu
465 470 475 480

Ser Glu Arg Pro Val Glu Val Leu Glu Ile Gly Asp Arg Ala Glu Ala
485 490 495

Ile Arg Val Leu Val Glu Trp Ala Gln Pro Gly Asp Gly Ile Val Val
500 505 510

Ala Gly Lys Gly His Glu Val Gly Gln Leu Val Ala Gly Val Thr His
515 520 525

His Phe Asp Asp Arg Glu Glu Gly Arg Ala Ala Leu Thr Glu Lys Leu
530 535 540

Asn Asn Lys Leu Pro Leu Thr Thr Glu Glu Gly
545 550 555

<210> 4
<211> 293
<212> PRT
<213> Brevibacterium lactofermentum

<400> 4
Met Ile Thr Met Thr Leu Gly Glu Ile Ala Asp Ile Val Gly Gly Arg
1 5 10 15

Leu Thr Gly Gly Ala Gln Glu Asp Thr Leu Val Ser Ser Ser Val Glu
20 25 30

Phe Asp Ser Arg Ser Leu Thr Pro Gly Gly Leu Phe Leu Ala Leu Pro
35 40 45

Gly Ala Arg Val Asp Gly His Asp Phe Ala Ala Thr Ala Ile Glu Lys
50 55 60

Gly Ala Val Ala Val Leu Ala Ala Arg Glu Val Asp Val Pro Ala Ile
65 70 75 80

Val Val Pro Pro Val Lys Ile Gln Glu Ser Asn Ala Asp Ile Tyr Ala
85 90 95

His Glu Pro Asp Gly His Gly Ala Ala Val Val Glu Ala Leu Ser Arg
100 105 110

Leu Ala Arg His Val Val Asp Ile Cys Val Ala Gly His Gln Leu Asn
115 120 125

Val Val Ala Ile Thr Gly Ser Ala Gly Lys Thr Ser Thr Lys Asp Phe

130 135 140

Ile Ala Thr Val Leu Gly Gln Asp Gly Pro Thr Val Ala Pro Pro Gly
145 150 155 160

Ser Phe Asn Asn Glu Leu Gly Leu Pro His Thr Val Arg Cys Thr Thr
165 170 175

Asp Thr Lys Tyr Leu Val Ala Glu Met Ser Ala Arg Gly Ile Gly His
180 185 190

Ile Lys His Leu Thr Glu Ile Arg Pro Pro Arg Ile Ala Ala Val Leu
195 200 205

Asn Val Gly His Ala His Leu Gly Glu Phe Gly Ser Arg Glu Asn Ile
210 215 220

Ala Gln Ala Lys Gly Glu Ile Ile Glu Ala Leu Pro Ser Lys Lys Thr
225 230 235 240

Gly Gly Val Ala Val Leu Asn Ala Asp Asp Pro Phe Val Ala Arg Met
245 250 255

Ala Pro Arg Thr Lys Ala Arg Val Val Trp Phe Thr Thr Asp Ala Gly
260 265 270

Gln Ala Lys Lys Ser Asp Tyr Trp Ala Thr Ser Ile Ser Leu Asp Ala
275 280 285

Val Ala Arg Ala Ser
290

<210> 5
<211> 30
<212> DNA
<213> Artificial Sequence

<220>
<223> Description of Artificial Sequence:primer

<400> 5
gcgcgaattc cgcaacctcg tcgtgacatg 30

<210> 6
<211> 340
<212> DNA
<213> Artificial Sequence

<220>
<223> Description of Artificial Sequence:primer

<400> 6
gcgcgaattc aagaccaata gccgcgattg cttg 34